GOVERNMENT EXPENDITURES AND ECONOMIC GROWTH IN RWANDA: A DISAGGREGATED ANALYSIS

Author: NYIRIGIRA David
Tel: +250 788 248 846
Email: n.ddavid.55@gmail.com
Supervisor: Dr. AFOLABI Luqman
October, 2022

1. Abstract

Over the past years, Rwanda has experienced sound economic development and an improvement in living standards. Differently, several researches argue that government expenditures in its sectors of government affect positively and negatively, in the long-run and in the short-run, the growth in the economy. The Keynesian theory states that public expenditure determines economic growth. This study assessed the effects of government expenditures on economic growth in Rwanda, using a disaggregated analysis specifically agriculture, health, defense, education, general public services and transport and communication, social protection and environmental protection using quarterly data from the year 2007 quarter three up to the year 2021 quarter four from Rwanda national budget execution reports, updated macro-economic framework public dataset from the Ministry of Finance and Economic Planning, and the World Development Indicators. The estimation technique employed is the ARDL together with ECM. This study resulted into both short run and long run, positive and negative effects of government expenditures to the economic growth in Rwanda. R^2 was tested to test the goodness of data fit, T-test was made to test the individual significance, F-test was used to test joint significance, the lag selection and unit root test were conducted to detect the stationarity, BG-test for autocorrelation was used to test if there is no serial or auto-correlation between the residual (u), Breusch-Pegan-Godfrey Test was made to test if the variance of the residual (u) is constant (Homoscedasticity), Skewness/Kurtosis tests for Normality, was applied to detect residual normality. We hope that this study will contribute to the expansion of knowledge and skills that will help policymakers and stakeholders to orient the government expenditures in different economic sectors and sub-sectors in Rwanda and worldwide.

2. Introduction

Researchers put a lot of effort intending to find the effects of government spending on economic growth in Rwanda and worldwide. The term government expenditure involves all government consumption, investment, and transfer payments made. Changes in aggregate demand, whether expected or unexpected, have the greatest short-run effect on real output and employment, but not on prices. Rwanda is one of East African countries, committed to various development programs, projects and reforms aiming at growing its economy in particular and achieving economic development generally. The desire for the government to finance these development programs made government expenditures to increase overtime. Because prices are somewhat rigid, Keynesians believe that, fluctuations in any sub-sector of government expenditures, consumption, investment, or government expenditures cause changes on output. For example, an increase in government, and all other expenditure components remain constant, then output will increase. Also, Keynesian models of economic activity include a multiplier effect which is changes in output by some multiple of the rising or reduction in spending that caused the change. If the fiscal multiplier is greater than one, then a one dollar increase in government spending would result in an increase in output greater than one dollar (Sarwat, Ahmed, & Papageorgiou, 2014).

The world bank reported that, Rwanda's public-sector led development model has shown limits, as in recent years public debt has increased significantly. Growth model of Rwanda has relied on large public investments 12.3 percent of gross domestic product in 2019) leading to substantial fiscal deficits financed mainly through external borrowing. Therefore, the debt-to-GDP ratio increased to 56.7 percent in 2019 (from 19.4 percent in 2010). External funding over grants, concessional and non-concessional borrowing played a significant role in funding government investments. Another side, the private sector will play a greater role to ensure economic growth. Stronger private sector can sustain high investment rate and quicken the growth. Inclusive growth also remains a serious challenge. To promote domestic savings is observed as critical. Then, the poverty reduction drive has deteriorated in 2020 and 2021 years, increasing the urgency to design a medium-term public investment strategy to achieve a more efficient allocation of resources toward projects to complete economic recovery after COVID-19.

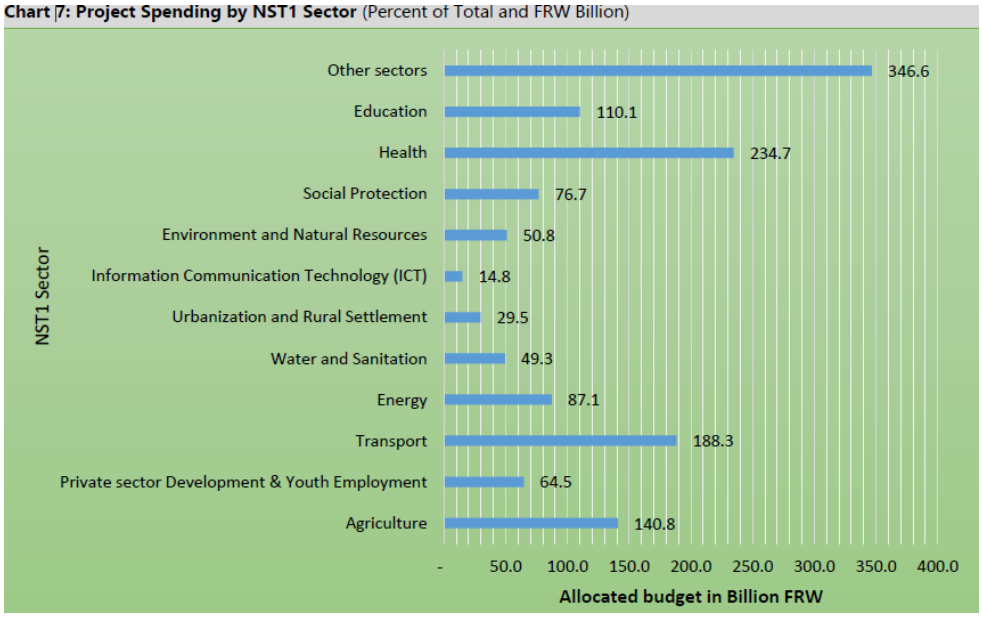
After the implementation of Economic Development and Poverty Reduction Strategy EDPRS II (2013-2018) Rwanda came up with the NST1, under EDPRS I and II Rwanda experienced robust economic and social performances. Growth of seven-point two percent over the period from 2010 to 2019, while per capita growth domestic product raised at 5 percent annually. The measures against COVID-19 pandemic, shortened economic activities in 2020. The government expects GDP to drop by 0.2 percent in 2020, compared to a projected expansion of 8 percent before the COVID-19 outbreak (The World bank, 2021).

Government expenditure, billion currency units in Rwanda Q1 2006 - Q1 2021, the average value for Rwanda during that period was 198.72 billion Rwanda Franc with a minimum of 64 billion Rwanda Franc in quarter one 2006 and a maximum of 439 billion Rwanda Franc in quarter two 2019. Government spending as percentage of GDP 1960 - 2020: For that indicator, the average value during that period was 13.15% with a minimum of 8.61% in 1968 and a maximum of 20.03% in 1981. The latest value from 2020 is 16.14%. By compering world average in 2020 based on 130 countries is 17.09% (The Global Economy, 2021).

The Rwandan economy was projected to grow by 5.1 percent in 2021 from the drop of 3.4 percent in 2020 following the actions put in place by Government to mitigate the economic impact of COVID-19. On the expenditure side, the Government of Rwanda intends to continue fiscal stimulus in the short-term and fast track economic recovery by allowing a gradual fiscal consolidation program while observing the regresses of economic impact of the pandemic. Fiscal deficits will be carefully managed

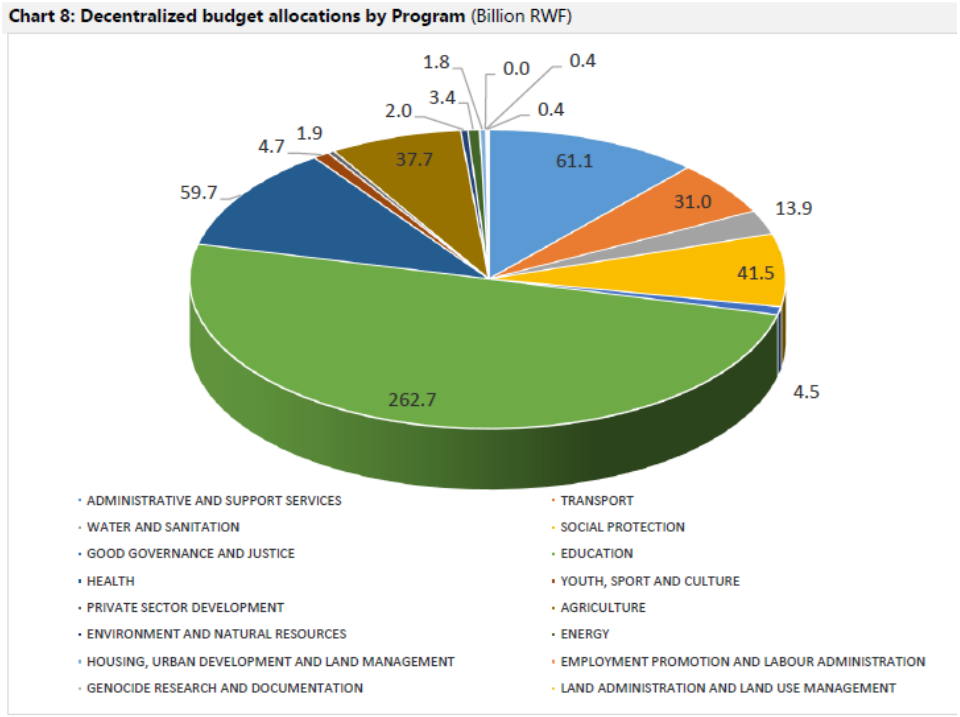
to ensure the maintenance of public debt at sustainable levels in the medium term. (MINECOFIN, 2022)

Figure 1:Projected Government expenditure 2021-2022 in Rwanda



Source: Rwanda budget factsheet 2021-2022

Figure 2: Rwanda projected decentralized budget by sector 2021/2022



Source: Rwanda budget factsheet 2021-2022

Rwanda is exposed to global economic developments mainly through trade links. Rwanda finances its import bill largely from export earnings-export receipts covered 41.1 percent of total import bill at end December 2018. The slowdown of the global economy is therefore a risk to the Rwandan economy as it affects demand for its exports of goods and services. The recent slump of agriculture

and metal prices on international market is therefore a challenge and risk to the Rwandan economy (Banque National du Rwanda (BNR) , 2019).

For the last two decades, Rwanda has recorded an impressive economic growth, modernization across all sectors and embarked on an ambitious development strategy seeking to transform the country from a law income, agriculture-based economy to a strong and diversified economy going forward. As results, Rwanda is among the fastest growing economies in Africa with the average annual growth of 8% over the last 2 decades, with many encouraging developments observed in both economic and social sectors (Nyalihama & Kamanzi, 2019). Real GDP is a useful measure of economic performance but more specifically, it is used to derive the output gap which is also used as a proxy for aggregate demand and it is one of the aggregate indicators of inflationary or deflationary pressures in the economy (Ferrara, 2008, Giannone, 2005, Billi, 2012) (Karangwa & Mwenese, 2015).

GDP at current prices in the 1st quarter of 2021, was projected to be Frw 2,579 billion, from Frw 2,410 billion in Q1 2020. In this quarter, services sector was 46% of GDP, agriculture sector was 27% of the GDP, industry sector was 20% of the GDP and 8% was attributed to adjustments. In the above said quarter, estimates in 2017 prices show that GDP was 3.5% higher than the same quarter of 2020. In the first quarter of 2021, total final consumption expenditure decreased by 2%, with Household final consumption declining by 2% while Government final consumption remained constant at 0% growth. Exports decreased by 19%, imports decreased by 22%while Gross Capital Formation increased by 3% (Murangwa, Murenzi, & Mwizerwa, 2021).

3. Literature review

Researchers put a lot of efforts intended to find the impact of government expenditure on economic growth and have found different results throughout different economies.

Economic growth is referred to an increase in total value of goods and services produced in the economy on annual basis. Therefore, economic growth is an increase in the national economies especially the gross domestic product per capita (GDP per capita) individually in the country. Based on the foregoing, IMF, classified economic growth as positive, negative and zero depending on the experiences of nations. For example, positive economic growth occurs when indicators of national annual average macroeconomic exceed the indicators of average growth of the national population growth. A negative economic growth gets up when the national annual average growth of indicators of macroeconomic is less than the growth of the national population growth. When the growth of annual macroeconomic indicators is equal to the growth of the annual national population is a zero economic growth. In addition, economic growth is classified as either intensive or extensive. Economic growth is classified as intensive when an increase in economic growth is due to more efficient use of inputs such as physical capital, labor, energy, technology and materials. However, an increase in the number of inputs available for use due to an increase in national growth, that is the extensive economic growth (Uremadu, Orikara, & Uremadu, 2019).

The IMF explained in below figure, Africa and Asia were projected to show the fastest economic growth, whereas Italy and Germany will lag behind the rest of the European union. Among African best performers, we can find Rwanda and Ethiopia (+7.8 percent and +7.7 percent respectively) in East Africa and Ghana (+8.8 percent) in West Africa. Ethiopia's economic growth is supported by significant foreign direct investment inflows, as well as by its agricultural potential and natural resources (ROSA, 2019).

3.1. An increase in government spending

At an unchanged interest rate, higher level of government spending increases the level of aggregate demand. Output must rise in order to meet the increased demand for goods. At each level of interest rate, equilibrium income must rise by $^{\alpha}_{G}$ times the increase in government spending. For example, if the government spending rises by one hundred and the multiplier is 2, equilibrium income must increase by 200 at each level of interest rate. Thus, the *IS* schedule shifts to the right by two hundred.
Due to an excess demand for real balances, the interest rate increases. Firms' planned investment spending declines at higher interest rates and thus aggregated demand falls (Dornbusch, Fischer, & Startz, 2011). The government revenues and expenditures activities influence economic outcomes. Keynesian theory emphasizes the market's lack of self-adjustment, particularly in the recessions. The government may have to intervene when the market doesn't self-adjust. Specifically, the government may have to use its tax and spending power (Fiscal policy) to stabilize the macro economy (Schiller, 2006). The case of Rwanda, as long as Rwanda continue to invest in different sectors such as agriculture, health, defense, education, transport, communication environmental and social protection and so on, expecting to have an economic growth either in long run or in short run period, so that in this study the researcher will examine the effect of government spending in the above sectors to the GDP growth in Rwanda.

3.2. Purchase Vs. Transfers

To understand how government spending affects aggregate demand, we must again distinguish between government purchase and income transfers. Government spending on defense, highways, and health care entail the purchase of goods and services in product market; they are parts of aggregate demand. By constant, the government doesn't buy anything when it mails out social security checks. The checks transfer income from taxpayers to retired workers. Income transfers doesn't become part of aggregate demand until the transfer recipients decide to spend that income. The government can alter aggregate demand by, purchasing more or fewer goods and services, raising or lowering taxes and changing the level of income transfer (Schiller, 2006).
While the main source of income of the government of Rwanda is tax revenues, its enhanced the effectiveness of taxation process through Rwanda Revenue Authority (RRA), in order to have enough budget to spend in purchase of good and service in different sectors such as agriculture, health, defense, education, transport, communication environmental and social protection and so on, expecting an economic growth. By the fiscal policy, Rwanda should increase or reduce government spending to stabilize the economy. The Rwanda social security board (RSSB) was also established to manage transfers in the Rwandan economy.

4. Theoretical framework and hypothesis development

This study is based on Keynesian theory which states that public expenditure determines economic growth (Sarwat, Ahmed, & Papageorgiou, 2014).
Keynesian economists justify government intervention through public policies that aiming to achieve full employment and price stability. If government spending increases and all other spending components remain constant, then output will increase. Keynesian models of economic activity also include a multiplier effect; that is, output changes by some multiple of the increase or decrease in spending that caused the change (IMF, 2014)
There have been two periods of intense work on growth theory, the first in the late 1950s and the 1960s and the second 30 years later, in the late 1980s and early 1990s. In the first period, research created neoclassical growth theory. Neoclassical growth theory focuses on capital accumulation and

its link to savings decisions and the like. The best-known contributor is Robert Solow. Technological progress is more focuses by the endogenous growth theory. Neoclassical growth theory commences with a simplifying assumption. (Dornbush, Fischer, & Startz, 2014)
Whether the income is the function of capital and the governments use to spend in capital, it means that, government expenditure may contribute to the economic growth, even if at the steady state the government do not spend more in capital but any time the government may invest in capital and operating expenditures. Rwanda may also need to invest in capital expenditure to stimulate the economic transformation as it is one of NST 1 economic transformation pillar.

5. Data and methodology

5.1. Study population

used data are secondary data in time series data that were collected using national budget execution report by sectors, through internet browsing on MINECOFIN, NISR and IMF web sites.
The study population were consisted of quarterly data on Real GDP and its independent variables of the period from 2007 Quarter three to 2021 Quarter four due to the availability of disaggregated data on each and all variables of interests.

The Autoregressive distribution lags (ARDL) and Error correction model (ECM) used in order to evaluate the short run effect of the government expenditures by sectors on economic growth and to interpret the speed for adjustment. This study used the STATA 14.

5.2. Data presentation and model specification

This study is based on Keynesian theory which states that public expenditure determines economic growth (Sarwat, Ahmed, & Papageorgiou, 2014).
Based on expansionary fiscal policy, which increases the aggregate demand, either by increases in government expenditures or through cutting taxes. When an economy is in recession and producing below its potential GDP, expansionary fiscal policy is most appropriate. Differently fiscal policy decreases the aggregate demand, either by cutting government expenditures or rising taxes. And when an economy is producing above its potential GDP, fiscal policy is most appropriate. A policy of budgetary expansion must be undertaken during recession period to rise the aggregate demand in the economy therefore, boosting the gross domestic product, the employment increases, revenues and benefits of the firms rise, and this would result into a situation that the companies hiring more workers to produce the goods and services needed by the government (BC CAMPUS , 2021);
The Keynesian model of economic growth as a function of public expenditure is as the following:

5.2.1. Output function

$$Y = f(GE)$$

Where Y is real GDP and GE is government expenditure.
Adopting the above Keynesian model with the specific objectives of this study as they involved the total government expenditures with its disaggregation into operating / recurrent and capital expenditures on quarter basis, the equation will be as follows:

5.2.2. Disaggregated output function

$$y = f[(AgrE, HltE, DefE, EdcE, GpsE, TraE, SocE, EnvE)Ut$$

5.2.3. Disaggregated output model with control and dummy variables

$$y = \beta_0 + \beta_1 AgrE_t + \beta_2 HltE_t + \beta_3 DefE_t + \beta_4 EdcE_t + \beta_5 GpsE_t + \beta_6 TraE_t + \beta_7 SocE_t + \beta_8 EnvE_t + \beta_9 FDI_t + \beta_{10} NX_t + D_t + u_t$$

Where small y is Real Gross Domestic Product (RGDP).
y: Real Gross Domestic Products; AgrE: Government expenditures in agriculture; HltE: Government expenditures in health; DefE: Government expenditures in defense; EdcE: Government expenditures in Education; GpsE: Government expenditures in general public services; TraE: Government expenditures on transport and communication; SocE: Government expenditures on social protection; EnvE : Government expenditures on Environmental protection. NX: Net Export (Export minus Import); FDI: Foreign direct investment; D: Dummy variable (COVID-19 Crises in 2020 and 2021); U: Error term and; t: Time period

5.2.4. Logarithmic output function

$$Log\ y\ t = \alpha_0 + \beta_1 log\ AgrE_t + \beta_2\ log\ H\ ltE_t + \beta_3\ log\ D\ efE_t + \beta_4\ log\ E\ dcE_t + \beta_5\ log\ G\ psE_t + \beta_6\ log\ T\ raE_t + \beta_7\ log\ S\ ocE_t + \beta_8\ log\ E\ nvE_t + \beta_9\ log\ F\ DI_t + \beta_{10} NX_t + D_t + \varepsilon_t$$

5.3. Estimation technics

We applied the Autoregressive Distributed Lag (ARDL) approach together with ECM technique. Equation which represents only the long-run equilibrium relationship and may form a co-integration set provided all the variables are integrated of order 0 and 1, that means I(0) and I(1).

5.3.1. Descriptive Statistics

The table 5 below provides a snapshot of descriptive statistics of the variables used to examining the relationship between government expenditures and economic grow in Rwanda during 58 quarters from 2007Q3 to 2021Q4. The table shows that the average Real GDP in 58 quarters was 1,682.5 billion Rwandan Francs per quarter. We noticed that Government expenditures in general public services has the largest share of 8.7% of Real GDP in average while the Government expenditures in Environmental Protection is still low where only 0.2% of Real GDP is used in this sector in average

5.3.2. Lags selection

We should also select the lag length before conducting unit roots test. We used information criterion (Akaike Information Criterion: AIC and Bayes Information Criterion: BIC)
The results of these information criteria suggesting one (1) lag, therefore we choose one (1) lag when testing stationarity and formulating our ARDL model.

5.3.3. Stationary testing /Unit root tests

The statistical procedure used to determine the stationarity of our time series data is unit root test where the test methods used are Augmented Dickey Fuller (ADF) and Phillips-Perron (P&P). The starting point is to examine the properties of the series graphically and confirming it statistically using unit root test. We should also select the lag length before conducting unit roots test.

5.3.4. Estimation procedure of Bound Tests

Firstly, we estimated equation employing OLS approach and then we conducted the Wald Test or F-Test for determining the joint significance of the coefficients of lagged variables for the purpose of examining the existence of long-run relationship among variables. The null hypothesis (H_0) is that:

No co-integration/Long run relationship among the variables, while the alternative hypothesis (Ha) is that: There is a long run relationship among the variables. The F-statistics was then compared with the critical values (upper and lower bound) given by (Pesaran, Shin, & Smith, 2001). If F-statistic is to be found above the upper critical value, the H0 of no co-integration can be rejected, which indicates that long-run relationship exists among the variables. Conversely, if F-statistic is found to be smaller than the lower critical value, the H_0 cannot be rejected implying no co-integration among the variables. However, if the F-statistic lies between lower and upper critical values, the test is inconclusive.

5.3.5. Estimation of ARDL Long Run and Bounds Test

Analysis of co-integration in order to examine the co-integration relationship among variables, the F-statistics under the Wald Test measures the join effect of all regressors. In short, the results revealed that there is long rung relationship among variables.

5.3.6. Estimation of Long Run Equation Using ARDL Model

The researcher assessed long run effect of Government expenditures on economic growth in Rwanda in order to estimate their effects and its magnitude, and the researcher used parsimony by dropping dummy variable in our model.

Table 1: Estimation ARDL long run and bound test

F-Stat	Critical Value	I(0)	I(1)	P-Value	Outcome
5.715958	1% significance level (***)	2.84	4.1	0.0000	Co-integration
	5% significance level(**)	2.33	3.46		Cointegration
	10% significance level(*)	2.07	3.16		Co-integration

Source: Authors' computation using STATA-14

5.3.7. Estimation of Short Run Equation Using ARDL Model

The researcher assessed the short run effect of Government expenditures on economic growth in Rwanda in order to estimate their effects and its magnitude.

6. Empirical findings and data analysis

6.1. Descriptive Statistics

The table below provides a snapshot of descriptive statistics of the variables used to examining the relationship between government expenditures and economic grow in Rwanda during 58 quarters from 2007Q3 to 2021Q4..

Table 2: Descriptive Statistics of variables of interest (in billion Rwf)

Variable	Average	% of average Real GDP	Max	Min	Standard Deviation
RealGDP	1,682.50	100%	2,572.0	994.0	446.0
AgrE	14.1	0.80%	55.4	3.5	9.9
HltE	30	1.80%	86.2	5.1	19.4
DefE	22.5	1.30%	54.8	8.6	10.3
EdcE	50.5	3.00%	155.7	13.6	24.0
GpsE	145.9	8.70%	557.3	20.3	118.1
TraE	18.8	1.10%	40.3	6.0	8.0

SocE	13.2	0.80%	25.8	2.2	6.5
EnvE	2.6	0.20%	8.0	0.4	1.6
NX	-222.4	-13.20%	- 60.0	- 379.0	- 84.2
FDI	42	2.50%	88.7	11.2	20.7

Source: Authors' computation 2022, using Excel Table

6.2. Lags selection

We should also select the lag length before conducting unit roots test. We used information criterion (Akaike Information Criterion: AIC and Bayes Information Criterion: BIC) The results of these information criteria suggesting one (1) lag, therefore we choose one (1) lag when testing stationarity and formulating our ARDL model (see annex#?).

Table 3: Lag-order selection criteria

```
 Sample: 3 thru 58                                       Number of obs = 56
+-------------------------------------------------------------------------+
| Lag |    LL      LR      df    p      FPE        AIC      HQIC      SBIC  |
|-----+-------------------------------------------------------------------|
|   0 | -64.7552                      6.8e-12   2.66983   2.81005    3.0315 |
|   1 |  181.306  492.12  100  0.000 3.9e-14* -2.54665  -1.00425*  1.43172* |
|   2 |  289.868  217.12* 100  0.000 4.0e-14  -2.85241*  .092179   4.74266  |
+-------------------------------------------------------------------------+
 * optimal lag
 Endogenous: lnRealGDP lnTraE lnGpsE lnEdcE lnDefE lnHltE lnAgrE lnFDI
             lnSocE lnEnvE
  Exogenous: _cons
```

Source: Authors' computation 2022, using STATA-14

6.3. Stationary testing /Unit root tests

The statistical procedure used to determine the stationarity of our time series data is unit root test where the test methods used are Augmented Dickey Fuller (ADF) and Phillips-Perron (P&P). The starting point is to examine the properties of the series graphically and confirming it statistically using unit root test. We should also select the lag length before conducting unit roots test.

Table 4: Augmented Dickey Fuller (ADF) Unit Root Test Results

Variable	At Level			First Difference			Order of Integration
	T/ADF Statistic	Critical Values	P-value	T/ADF Statistic	Critical Values	P-value	
LogRGDP	-3.876	-4.137*** -3.494** -3.176*	0.0131	-	-	-	I(0) at 5% significance level
LogAgrE	-3.998	-4.139*** -3.495** -3.177*	0.0089	-	-	-	I(0) at 5% significance level
LogHltE	-3.811	-4.137*** -3.494** -3.176*	0.016	-	-	-	I(0) at 5% significance level
LogDefE	-2.455	-4.137 -3.494 -3.176	0.3508	-5.423	-4.139*** -3.495** -3.177*	0	I(1) at 1% significance level
LogEdcE	-2.817	-4.137 -3.494 -3.176	0.1906	-6.276	-4.139*** -3.495** -3.177*	0	I(1) at 1% significance level
LogGpsE	-3.603	-4.137*** -3.494** -3.176*	0.0296		-	-	I(0) at 5% significance level
LogTraE	3.301	-4.137 -3.494 -3.176	0.0661	-8.252	-4.139*** -3.495** -3.177*	0	I(1) at 1% significance level
LogSocE	-3.225	-4.137 -3.494 -3.176	0.0796	-7.844	-4.139*** -3.495** -3.177*	0	I(1) at 1% significance level
LogEnvE	-3.215	-4.137 -3.494 -3.177	0.0814	-8.247	-4.139*** -3.495** -3.177*	0	I(1) at 1% significance level
NX	-3.049	-4.137 -3.494 -3.178	0.1188	-7.81	-4.139*** -3.495** -3.177*	0	I(1) at 1% significance level
LogFDI	-3.003	-4.137 -3.494 -3.179	0.1313	-5.142	-4.139*** -3.495** -3.177*	0	I(1) at 1% significance level
D	-1.077	-10.811	0.9329	-5.142	-4.139*** -3.495** -3.177*	0	I(1) at 1% significance level

(***),(**) & (*) represent critical value at 1%, 5% & 10%

Source: Authors' computation 2022, using STATA-14

Table 5: Philips-Perron (PP) Unit Root Test Results

Variable	At Level			First Difference			Order of Integration
	T/ADF Statistic	Critical Values	P-value	T/ADF Statistic	Critical Values	P-value	
LogRGDP	-4.174	-4.135*** -3.493** -3.176*	0.0049	-	-	-	I(0) at 1% level of significance
LogAgrE	-6.243	-4.135*** -3.493** -3.176*	0.0000	-	-	-	I(0) at 1% level of significance
LogHltE	-5.025	-4.135*** -3.493** -3.176*	0.0002	-	-	-	I(0) at 1% level of significance
LogDefE	-3.604	-4.135*** -3.493** -3.176*	0.0295	-12.023	-4.137*** -3.494** -3.176*	0.0000	I(0) at 5% and I(1) at 1% significance levels
LogEdcE	-3.993	-4.135*** -3.493** -3.176*	0.009	-10.843	-4.137*** -3.494** -3.176*	0.0000	I(0) at 5% and I(1) at 1% significance levels
LogGpsE	-4.444	-4.135*** -3.493** -3.176*	0.0019	-	-	-	I(0) at 1% level
LogTraE	-4.209	-4.135*** -3.493** -3.176*	0.0043	-10.291	-4.137*** -3.494** -3.176*	0.0000	I(0) at 5% and I(1) at 1% significance levels
LogSocE	-4.042	-4.135*** -3.493** -3.176*	0.0077	-10.013	-4.137*** -3.494** -3.176*	0.0000	I(0) at 5% and I(1) at 1% significance levels
LogEnvE	-3.588	-4.135*** -3.493** -3.176*	0.0309	8.607	-4.137*** -3.494** -3.176*	0.0000	I(0) at 5% and I(1) at 1% significance levels
NX	-3.682	-4.135*** -3.493** -3.176*	0.0236	-9.564	-4.137*** -3.494** -3.176*	0.0000	I(0) at 5% and I(1) at 1% significance levels
LogFDI	-2.891	-4.135 -3.493 -3.176	0.1652	-7.419	-4.137*** -3.494** -3.176*	0.0000	I(1) at 1% significance level
D	-0.307	-3.57 -2.924 -2.597	0.9245	-7.697	-4.137*** -3.494** -3.176*	0.0000	I(1) at 1% significance level

(***),(**) & (*) represent critical value at 1%, 5% & 10%

Source: Authors' computation using STATA-14

The tables above the results of both ADF and PP tests, which are consistent in establishing same order of integration for each variable. It can be observed from the tables 1 and 2 that the Real GDP, Government expenditures in agriculture, Government expenditures in health and Government expenditures in general public services are stationary at level, other variables such as Government expenditures in defense, Government expenditures in Education, Government expenditures on transport and communication, Government expenditures on social protection, Government expenditures on Environmental protection, Net Export (Export minus Import) and Foreign direct investment and Dummy variable are found to be non-stationary at levels for ADF test but they all became stationary after taking their first difference at 1% level of significance.

This depicts that they are all integrated at I(1). None of the variables is integrated of order 2 or beyond making it possible to employ ARDL approach to co-integration for the regression analysis. From the results of ADF and PP tests, ARDL approach to co-integration is more suitable to analyze the data than others like Johansen co-integration approach.

6.4. Estimation procedure of Bound Tests

Firstly, we estimated equation 2 employing OLS approach and then we conducted the Wald Test or F-Test for determining the joint significance of the coefficients of lagged variables for the purpose of examining the existence of long-run relationship among variables. The null hypothesis (H0) is that: No co-integration/Long run relationship among the variables, while the alternative hypothesis (Ha) is that: There is a long run relationship among the variables. The F-statistics was then compared with the critical values (upper and lower bound) given by (Pesaran, Shin, & Smith, 2001).

If F-statistic is to be found above the upper critical value, the H0 of no co-integration can be rejected, which indicates that long-run relationship exists among the variables. Conversely, if F-statistic is found to be smaller than the lower critical value, the H0 cannot be rejected implying no co-integration among the variables. However, if the F-statistic lies between lower and upper critical values, the test is inconclusive.

6.5. Estimation of ARDL Long Run and Bounds Test

Analysis of co-integration in order to examine the co-integration relationship among variables, the F-statistics under the Wald Test measures the join effect of all regressors. The calculated F-statistics was found to be 5.715958, which is greater than upper bound (i.e I(1)) critical values which are 4.1, 3.46 and 3.16 , and hence it indicates that null hypothesis of no co-integration is reject at both 1% & 5% significance levels. In short, the results revealed that there is long rung relationship among variables.

Table 6: Estimation of ARDL Long Run and Bounds Test

F-Stat	Critical Value	I(0)	I(1)	P-Value	Outcome
5.715958	1% significance level (***)	2.84	4.1	0.0000	Co-integration
	5% significance level(**)	2.33	3.46		Cointegration
	10% significance level(*)	2.07	3.16		Co-integration

Source: Source: Authors' computation 2022, using STATA-14

6.6. Estimation of Long Run Equation Using ARDL Model

Assessment of long run shows results in long run (table 6). It was found that Government expenditures in health, and Foreign direct investment and Government expenditures on transport and

communication have a positive and statistically significant effects on Real GDP in long run while Government expenditures on social protection, Government expenditures in general public services have a negative and statistically significant effects on Real GDP which are the expected signs for these variables. On the other hand, the other variables (Government expenditures in agriculture, defense, education, environment and net export) are found not statistically significant in long run. Note that we used parsimony by dropping dummy variable in our model.

Table 7: Estimated Long-Run Coefficients Using ARDL Model

Variable	Coefficient	T-Value	P-Value
LogAgrE	-0.005051	-0.445895	0.6587
LogHltE	0.081356**	2.524412	0.0167
LogDefE	0.011620	0.714951	0.4798
LogEdcE	0.0008124	0.362498	0.7194
LogGpsE	-0.057715*	-2.012272	0.0527
LogTraE	0.064629***	2.972689	0.0056
LogSocE	-0.114750***	-2.816000	0.0083
LogEnvE	0.010694	1.217940	0.2322
NX	-1.16E-13	-0.101137	0.9201
LogFDI	0.064939***	6.245440	0.0000

(***),(**) & (*) represent critical values at 1%, 5% & 10%, the negative sign of NX (Net Export) is due to the fact that Imports exceed Export).

Source: Authors' computation 2022, using EViews

6.7. Estimation of Short Run Equation Using ARDL Model

Assessment of short run shows results in short run (table 7). It was found that government in general public services, government expenditures on social protection, and Foreign direct investment have a positive and statistically significant effects on Real GDP in short run while government expenditures in agriculture, government expenditures in health, government expenditure on transport and communication and net export have a negative and statistically significant effects on Real GDP which are the expected signs for these variables.

Table 8: Estimated Short-Run Coefficients Using ARDL Model

Variable	Coefficient	T-Value	P-Value
LogRGDP(-1)	0.231916**	2.399616	0.0224
LogAgrE	-0.018610***	-3.562007	0.0012
LogHltE	0.56704******	4.979131	0.0000
LogHltE(-1)	-0.055430***	-4.085722	0.0003
LogGpsE	-0.008772	-0.729058	0.4713
LogGpsE(-1)	0.035492***	4.979131	0.0000
LogTraE	0.045963****	4.756376	0.0000
LogTraE(-1)	-0.041729***	-3.750553	0.0007
LogSocE	-0.077516***	-5.724541	0.0000
LogSocE(-1)	0.074503***	4.553612	0.0001
NX	-3.61E-13***	-5.127680	0.0000
LogFDI	0.048633***	4.737866	0.0000
ECM(-1)	-0.945962***	-9.084280	0.0000

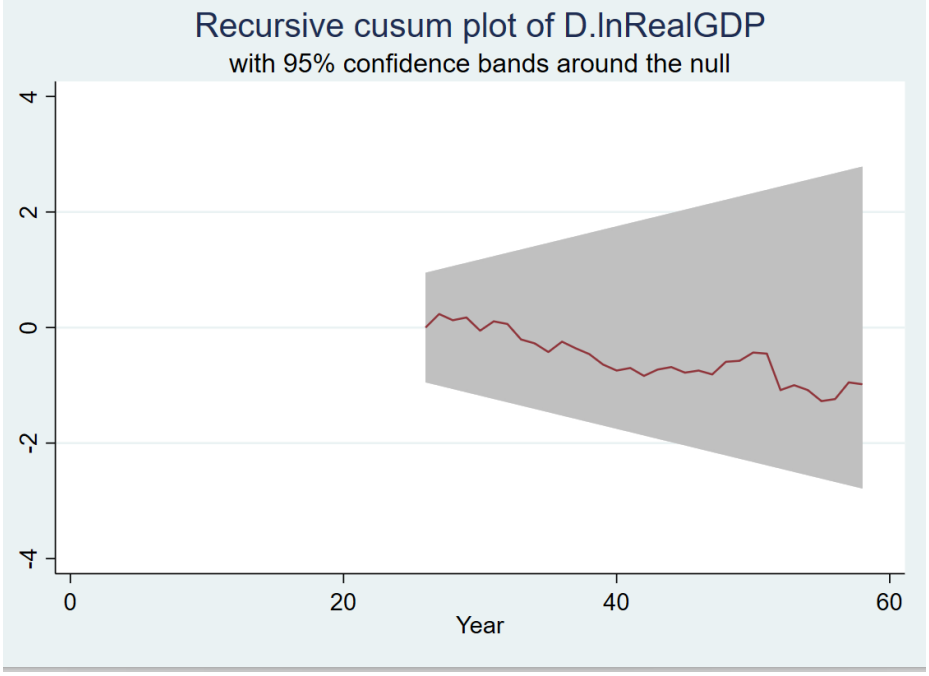
(***),(**) & (*) represent critical values at 1%, 5% & 10%, ECM: Error Correction Model, the negative sign of NX (Net Export) is due to the fact that Imports exceed Export). Note that variables with (-1) represent their lags,

Source: Authors' computation 2022, using EViews

7. Post-Estimation

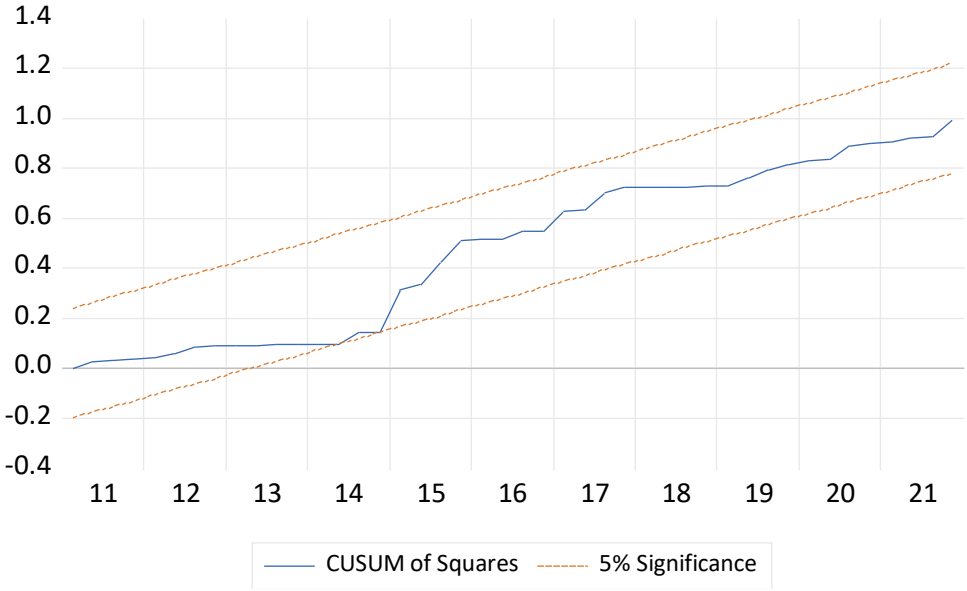
7.1. Stability test

Figure 3: The graphs show that the data are stable from 2007q3 to 2021q4



Source: Authors' computation 2022, using EViews

Figure 4: Cusum of Squares test



Source: Authors' computation 2022, using EViews

7.2. Serial correlation test

To test Serial correlation, Breusch-Godfrey test was used. The result below shows that P-value is 0.0939 which great than 0.05, therefore we fail to reject the null hypothesis (Ho: No serial correlation at up to 12 lags). In the other words, there is no correlation between residuals.
Rule: If p-value is less than 5%, we reject Ho
H0: No serial correlation
H1: Serial correlation

Table 9: Serial correlation results

Number of gaps in sample: 3

Breusch-Godfrey LM test for autocorrelation

lags(p)	chi2	df	Prob > chi2
12	18.782	12	0.0939

H0: no serial correlation

Source: Authors' computation 2022, using STATA-14

7.3. Heteroskedasticity test

To run this test Breusch-Pagan / Cook-Weisberg test was used. The results below show that P-value is 0.6185 which great than 0.05, therefore we fail to reject the null hypothesis (Ho: Homoskedasticity). In the other words, the mean of residuals is zero and variance of them is constant.
Rule: If p-value is less than 5%, we reject Ho
H0: Homoskedasticity
H1: Heteroskedasticity

Table 10: Heteroskedasticity test results

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of logRGDP
chi2(1) = 0.25
Prob > chi2 = 0.6185

7.4. Normality test

The results below show that we fail to reject the Ho: Residuals are normally distributed because p-value is 0.5147 and greater than 5%. We conclude that the residuals are normally distributed.
Rule: If p-value is less than 5%, we reject Ho
H0: Residuals are normally distributed
H1: Residuals are not normally distributed

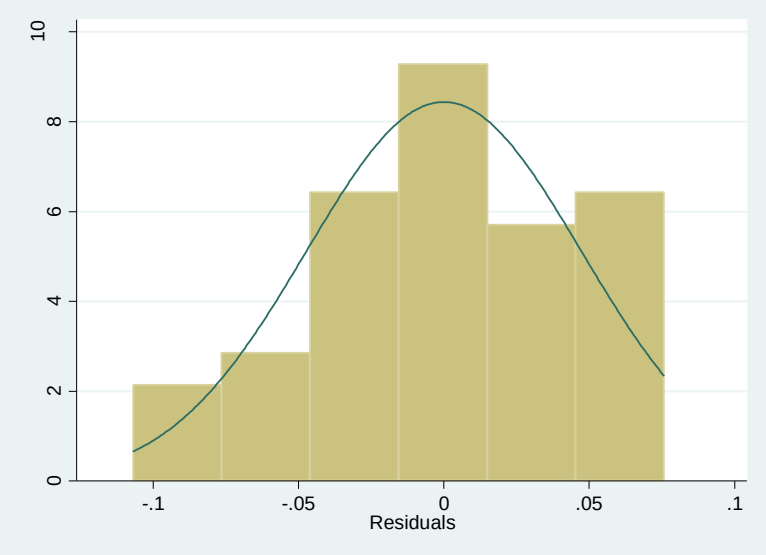
Table 11: Normality test outputs

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	Prob>chi2
resid	46	0.3490	0.5327	1.33	0.5147

histogram resid, normal

(bin=6, start=-.10693698, width=.03045606)
Source: Authors' computation 2022, STATA-14
Table 12: Normality test presentation



Source: Authors' computation 2022, using EViews

7.5. Test of significance of the model

This test was carried out by using Wald Test. The STATA software package computes easily the F-values and P-values of OLS estimates.
Hypotheses to test are:
Null hypothesis (H_0): the coefficients of independent variables are zero
Alternative hypothesis (H_1): At least one of them is not zero
Rejection rule: If F-value is greater than critical value Fc

- We reject H_0 otherwise we fail to reject it. Or
- if the p-value is less than or equal to level of significance $\alpha = 0.05$ We reject the null hypothesis.
- Otherwise we fail to reject it.

In the other words: If F>Fc or Prob(F-statistic)<0.05 we reject H_0 otherwise we fail to reject it. The level of significance is =0.05=5%.
Looking at the results below, we see that F-value=18.68 and p-value=0.0000. The critical value Fc=2.29
Since F=18.68>2.29 or Prob(F-statistic)=0.0000<0.05 ,we reject the strong null hypothesis that all coefficients of independent variables are zero
Conclusion: At least one of the coefficients is not zero. Hence, we reject the null hypothesis and conclude that our model is more significant.

8. Brief interpretation of ECM regression outputs

8.1. Goodness of fit

The goodness of fit is measured by adjusted R^2=70.45%; the interpretation of R^2 is that 70.45.% of the variation in the Real GDP (RGDP) is explained by independent variables.
The short-run dynamics coefficients from the estimated ARDL (2,1,0,0,0,0,2,2,2,2,1) model are summarized (in table 5). Where, the lag is selected by Akaike information with automatic selection option.

8.2. Short Run Effect of Government expenditure on economic growth

The table 5 shows that the estimated lagged error correction term ECM (-1) is -0.945962 which is highly significant at 1% level of significance and negative (ranges between zero and one) as was expected having probability values less than 1% which is 0.0000. These results show that almost 94.59% of the discrepancy between the long run and short run is corrected within a quarter.

In short run, we found that lagged variables of Real GDP, government expenditures in general public services, government expenditures on social have a positive effect on current Real GDP, while government expenditures in health and government expenditures on transport and communication and have a negative effect on current real GDP.

We also found that in short run, government expenditure in agriculture has a negative effect on Real GDP where a 1% increase in it leads to 0.02% decrease in economic growth, ceteris paribus. This result is in line with the findings of HARERIMANA Bernard in 2016, while the analysis shown a general significance of government expenditure to agricultural sector and significant impact on economic growth.

Government expenditures in health has positive effect on real GDP where a 1% increase in it leads to 0.56% increase in Real GDP ceteris paribus. Which is in different from findings by Donald and Shuanglin in 1993 investigated the differential impact of various types of the government expenditures on economic growth from 58 countries found that the growth rate of welfare expenditures has an insignificant negative impact on economic growth.

Government expenditures on social protection have a negative effect on current Real GD where a 1% increase in it leads to 0.07% decrease in Real GDP. Which is in different from findings by Donald and Shuanglin in 1993 in 58 countries found that the growth rate of welfare expenditures has an insignificant negative impact on economic growth

We can also note that in short run, government expenditures on transport and communication and foreign direct investment have a positive effect on Real GDP where a 1% increase in each government expenditures on transport and communication and foreign direct investment leads to 0.045% and 0.048% increase in them respectively. Similar with Gilbert NDIBANJE's findings in 2019 that found that holding other factors constant, 1% increase on total government expenditures results in 0.51% increase in real GDP in short run.

8.3. Long run effect of government expenditure on economic growth in Rwanda

The positive coefficient of Government expenditures in health of 0.081356 indicates that in long-run a 1% increase in Government expenditures in health will lead to 0.08% increase in Real GDP, holding other variables constant. Which is different from paper published by Donald and Shuanglin in 1993 in 58 countries found that the growth rate of welfare expenditures has an insignificant negative impact on economic growth.

The estimated coefficient of Government expenditures on social protection is -0.1147 and is negative which can explain that there is a negative relationship between Government expenditures on social protection and economic growth, where 1% increase in Government expenditures in on social protection lead to 0.1% decrease in Real GDP, holding other variables constant. In general, the government expenditures in Socio protection can affect economic growth negatively in long term.

This phenomenon can probably be linked to the unproductive expenditures in this sector. This may be also due to low levels of government expenditures in the mentioned sector and the inefficiency with which these expenditures are converted into human capital stock and thus into economic growth. This finding is somehow different from paper published by Donald and Shuanglin in 1993 investigated the differential impact of various types of the government expenditures on economic growth from 58 countries found that the growth rate of welfare expenditures has an insignificant negative impact on economic growth. But the negative sign found the same as found by this study.

Again, the Government expenditures in general public services has been found to have the negative impact on real GDP with coefficient of -0.0577. This can simply mean that a 1% increase in Government expenditures in general public services, leads to 0.06% decrease in economic growth holding other variables constant.

The coefficient of Government expenditures on transport and communication has been also found positive (0.0646) which can be interpreted as a 1% increase in Government expenditures on transport and communication leads to an increase of 0.06% in economic growth ceteris paribus.

The results in table 6 revealed that there is a positive relationship between foreign direct investment (FDI) and Real GDP, where the estimated coefficient is 0.06493 which can be interpreted as follows: A 1% increase in Government Foreign direct investment leads to 0.06% increase in economic growth, holding other variables constant. Similar with Gilbert NDIBANJE's findings in 2019.

On the other hand, we found that other remaining variables (Government expenditures on agriculture, defense, education, environmental protection and Net Export as well) are not statistically significant (see table 6). This result is different from the finding from the study conducted by HARERIMANA Bernard in 2016, the analysis shown a general significance of government expenditure to agricultural sector and significant impact on economic growth. Also, different from also the paper published by Donald and Shuanglin in 1993 investigated the differential impact of various types of the government expenditures on economic growth. Evidance from 58 countries suggests that:

(1) The growth rate of educational expenditures has a significant positive impact on economic growth;
(2) The growth rate of defense expenditures has a positive impact on economic growth that is insignificant for all 58 countries but significant of a sub set of 47 countries for which data should be available sustainably.

9. Conclusion

The government expenditures affect both positive and negatively the economic growth in both short run and long run, with some lagged variables effects as well. Which is similar with results by Gilbert NDIBANJE in 2019 that was aiming to examine the impact of government spending on economic growth in Rwanda, found significant negative and positive both short run and long run effect of total government expenditures on economic growth in Rwanda.

References

Australian institute of health and welfare. (2021). *Recurrent expenditure*. Retrieved from Australian institute of health and welfare web site: https://meteor.aihw.gov.au

Banque National du Rwanda (BNR) . (2019). *Annual financial stability report.* Kigali: BNR.

Baum, D. N., & Lin, S. (1993). The differential effects on economic growth of government expenditures on education, walfare and defense. *Journal of weconomic development*, 1-12.

BC CAMPUS . (2021). *principlesofeconomics/chapter/30-4-using-fiscal-policy-to-fight-recession-unemployment-and-inflation/*. Retrieved from BC CAMPUS web site: https://opentextbc.ca

BEA. (2019, November). *Net export.* Retrieved from BEA WEB SITE : https://www.bea.gov/system/files/2019-12/Chapter-8.pdf

Britany Tang, B. (2020). Understanding COVID 19: Global pandemic. *ATCC*, 1.

Business standard. (2021). *About/what-is-capital-expenditure*. Retrieved from Business standard web site: https://www.business-standard.com

Cavallo, M. (2005). Government Consumption Expenditures and the current account. *Federal Reserve Bank of San Francisco*, 1.

Dornbusch, R., Fischer, S., & Startz, R. (2011). *Macroeconomics, Eleventh Edition.* New York: McGraw-Hill.

Dornbush, R., Fischer, S., & Startz, R. (2014). *Macroeconomics : 12th Edition.* New York: McGraw Hill Education.

Galí, J., López, D. L., & Vallés, J. (2007). *Understanding the effects of government spending on consumption; Working paper series No 339.* Kaiserstrasse 29: European central bank.

Harerimana, B. (2016). Analysis of Government Spending on Agriculture Sector and its Effects on Economic Growth in Rwanda. *UR*.

HinRich foundation . (2022, Jan). *FDI*. Retrieved from Hinrich foundation web site: https://www.hinrichfoundation.com/global-trade/foreign-direct-investment/?utm_term=fdi%20foreign%20direct%20investment&utm_campaign=Search+%7C+Generic+%7C+Brand+Awareness&utm_source=adwords&utm_medium=ppc&hsa_acc=8724352572&hsa_cam=17534221351&hsa_grp=136

IMF. (2014). What is Keynesian economics . *Finance and developent*.

Index Mundi. (2019). *facts/indicators/SE.XPD.TOTL.GB.ZS/map/africa*. Retrieved from Index Mundi: https://www.indexmundi.com

Investopedia. (2021, January 01). *Macroeconomics* . Retrieved from Investopedia web site: https://www.investopedia.com

Karangwa, M., & Mwenese, B. (2015). *Economic review. Vol. 7 : Modeling GDP in Rwanda.* Kigali: Banque National du Rwanda (BNR).

Karuhanga & Nyirakanani. (2016). *BNR Economic review Vol 9 : Effects of Fiscal Policy on Inflation and Money Market Interest Rates in Rwanda.* Kigali: Banque National du Rwanda (BNR).

Karuhanga & Nyirakanani. (2016). *BNR Economic review. Vol. 9: Effects of Fiscal Policy on Inflation and Money Market Interest Rates in Rwanda.* Kigali: Banque National du Rwanda (BNR).

Karuhanga, W. K., & Nyirakanani, R. (2016). *BNR Economic review Vol. 09: Effects of Fiscal Policy on Inflation and Money Market Interest Rates in Rwanda.* Kigali: Banque National du Rwanda (BNR).

Management Mania. (2016). *en/general-public-services*. Retrieved from Management Mania web site: https://managementmania.com

MINALOC . (2020). *National social protection policy* . Kigali: MINALOC.

MINECOFIN. (2022). *Budget factsheet* . Kigali : MINECOFIN.

Murangwa, Y., Murenzi, I., & Mwizerwa, J. C. (2021). *Gross Domestic Product 2021 Q1*. Kigali: NISR.

My accounting course. (2021). *Accounting-dictionary/government-expenditures*. Retrieved from My accounting course: https://www.myaccountingcourse.com

Ndibanje, G. (2020, March 17). Impact of Government Expenditures on Economic Growth in Rwanda. *Academic Publishing*. Chisinau: LAP LAMBERT.

Nembot, N. L., Melachio, T. A., & Kos, A. M. (2021). Effects of Public Expenditure on Economic Growth in the CEMAC Subregion: A Comparative Analysis between the Fragile and Non-fragile States. *African Economic Research Consortium, Nairobi*, AERC Working Paper FW-006.

Nyalihama & Kamanzi. (2019). *BNR Economic review Vol. 15: Financial sector development and impact on economic growth in Rwanda.* Kigali: Bank National du Rwanda (BNR).

Nyalihama, C., & Kamanzi, C. (2019). *BNR Economic review. Vol.15: Financial sector development and impact on GDP in Rwanda.* Kigali: Banque National du Rwanda (BNR).

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Wiley online library* , 1.

ROSA, D. (2019, April 17). *en/magazine/article/2019/04/17/2019-forecast-map-global-economic-growth/*. Retrieved from Export planning web site: https://www.exportplanning.com

Sarwat, J., Ahmed, S. M., & Papageorgiou, C. (2014, September 1). *What Is Keynesian Economics?* Retrieved from International monetary fund web site: https://www.imf.org/external/pubs/ft/fandd/2014/09/pdf/basics.pdf

Schiller, R. B. (2006). *The economy today; Tenth Edition.* New York: McGrae Hill Irwin.

Seshajah, S. V., Reddy, T., & Sarma, I. R. (2018). General Government Expenditure and Economic Growth in India: 1980-81 to 2015-16. *: Theoretical economic letter: Scientific research publishing, Vol.8 No:4*, 8,728-740.

The Global Economy. (2021). *Rwanda: Government spending, percent of GDP*. . Retrieved from Global economy web site: https://www.theglobaleconomy.com

The World bank. (2021, March 14). *The world bank in Rwanda*. Retrieved from World bank group web site: https://www.worldbank.org

U.S Department of transportation. (2017). *sites/bts.dot.gov/files/docs/explore-topics-and-geography/topics/transportation-and-economy/210941/investment-transportation-assets.pdf*. Retrieved from US department of transportation web site: https://www.bts.gov/sites

UN. (2018, June). *United nations social protection* . Retrieved from observatoriosocial.cepal web site: https://observatoriosocial.cepal.org

UNESCO Institute of Statistics. (2019, April 10). *Capital expenditures*. Retrieved from Investopedia web site: https://www.investopedia.com

Uremadu, S. O., Orikara, P. C., & Uremadu, C. (2019). Testing Relationship between Government Current Expenditures and Economic Growth in Nigeria. *Scientific research publishing: Theoretical Economics Letters*, 9, 584-604.

World Health Organization. (2021). *data/nutrition/nlis/info/health-expenditure*. Retrieved from WHO web site: https://www.who.int